

Palomar Radio Control Flyers

Ground School

Batteries and Chargers



THUNDER POWER
LITHIUM POLYMER
5000mAh
66 Pro Lite
5000mAh 4-Cell 14.8V (74 Wh)
25C Continuous Discharge, Burst (11.5A/250mA)
Charge at 0.5A Max

Elite High-Power Series
Lithium Polymer Battery
3S 11.1V 3000mAh 30C LiPo (33.3Wh)
25C (500mA) Maximum Continuous Discharge
30C (600mA) Maximum Continuous Discharge

ElectriFly
LITHIUM-POLYMER BATTERY
3S 11.1V 25Wh
4500mAh 30C 11.1V 25Wh
Charge at 1.2A Max

THUNDER POWER
LITHIUM POLYMER
850mAh
45
850mAh 3-Cell 11.1V (9.4 Wh)
25C Continuous Discharge, Burst (1.5A/150mA)
Charge at 0.5A Max

ElectriFly
LITHIUM-POLYMER BATTERY
550mAh 25C
11.1V 10Wh
Charge at 0.55A Max

THUNDER POWER
LITHIUM POLYMER
850mAh
45
850mAh 3-Cell 11.1V (9.4 Wh)
25C Continuous Discharge, Burst (1.5A/150mA)
Charge at 0.5A Max

Elite High-Power Series
Lithium Polymer Battery
3S 11.1V 400mAh (3 Wh)
25C (500mA) Maximum Continuous Discharge
30C (600mA) Maximum Continuous Discharge
Please read all safety precautions before use.

XENO
5000
7.4V 5000mAh 35C 37Wh LiPo BATTERY
Duratrax

THUNDER POWER
LITHIUM POLYMER
910mAh
66 Pro Lite
25C
910mAh 3-Cell 11.1V (10 Wh)
25C Continuous Discharge, Burst (1.5A/150mA)
Charge at 1.2A Max

FlightPower EON
2100 mAh 2S 7.4V LiPo
25C

BROMIDA
7.4V 1600mAh 20C 12Wh
LiPo Battery

4S-3200
5

ElectriFly
LITHIUM-POLYMER BATTERY
3000mAh 30C
11.1V 15Wh
Charge at 1.3A Max

The Old Days

- ◉ NiCad

- ◉ Nickel Cadmium

- ◉ Had to fully cycle the batteries to avoid memory effect

- ◉ Dangerous for the environment

- ◉ NiMH

- ◉ Nickel Metal Hydride

- ◉ No memory effect

- ◉ Safer for the environment

Current Technology

- LiPo



- Lithium Polymer

- LiPo Graphene



- Better for high power applications

Current Technology

- LiIon (Lithium Ion)

- Commonly used in computers and portable devices
- Great for low current draw - long life situations and sustained flight for small aircraft



- LiFe (Lithium Iron Phosphate)

- Great for powering receiver and servos
- Flat Power Curve
- OK to keep fully charged
- Low discharge rate



LiPo Designations

- LiPo
 - Cell Count
 - Current Designations
 - C-Ratings
 - Internal Resistance
 - Connectors



- In LiPo batteries, each cell is rated nominally at 3.7 volts
- At full charge each cell has a rating of 4.2 volts
- Never discharge your battery below 3.3 volts
- Store your batteries at 3.85 volts per cell
- Never charge your batteries $>4.2\text{v}$ per cell

What's with all the
S's and C's??

The S Rating

- The "S" designates how many cells are in SERIES
 - With a nominal fully charged voltage of 4.2v per cell
 - 3S (3 cells in series) = 12.6v
 - 4s = 16.8v, etc.
- Sort of like a gas tank. The bigger the tank, the longer you can drive.
- Why do we use voltage to determine how much power is left in the battery?

"C" Ratings

- "C" stands for Discharge Rating (Current Capacity).
- The higher the C rating, the better a battery can handle extreme loads
- $1000\text{mAh} = 1 \text{ Amp Hour (1Ah)}$
- For example:
 - A 2000mAh 20C pack will deliver 40 amps continually ($20 \times 2000\text{mAh} = 40 \text{ amps}$)
 - A 2000mAh 40C pack will allow you to draw 80 amps from it continually
- In theory, you can charge a higher C rating pack faster due to its current handling capacity, but I recommend only charging at the 1C rate.

Internal Resistance (IR)

- Designates the level of difficulty a battery has delivering power
- Not shown on any battery labeling
- IR changes over time with every battery
- The higher the IR, the more difficult it is to deliver needed power
- The cell with the highest IR is the weakest link and can get very hot if different from the other cells

Internal Resistance

- To measure your batteries:
 - Some chargers have IR functions
 - You can buy a separate IR meter
- IR is expressed in milliohms ($m\Omega$)
- $IR > 10-15 m\Omega$ per cell is poor quality
- Summary – A pack with higher IR will deliver proportionally less performance



Cells

IR

Info |

1	3.6mΩ	6	2.3mΩ
2	3.0mΩ	7	
3	2.2mΩ	8	
4	2.9mΩ	9	
5	2.1mΩ	10	

S_R 16.1mΩ

Internal Resistance

306B

Benchmark a New Battery

1: 2 2 3 P02
4: 3 2 3 P02

1000W

CE

- LiPo/LiIo/LiFe: 1 - 6 series
- NiMH/NiCd: 1 - 25 series
- Lead acid/Pb: 2 - 36V
- Charge: 0.05 - 30.0A
- Discharge: 0.05 - 30.0A
- PC connection: USB port
- Memory settings: 10 sets
- Log memory: 16Mbit flash

Batt type

Dec

Inc

Start



Stop

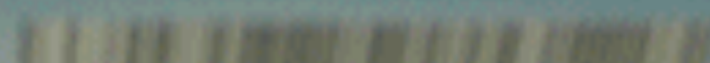
← Status →

Enter



1R = 2, 2, 3, 3, 2, 3

GLACIER™



Battery Connectors

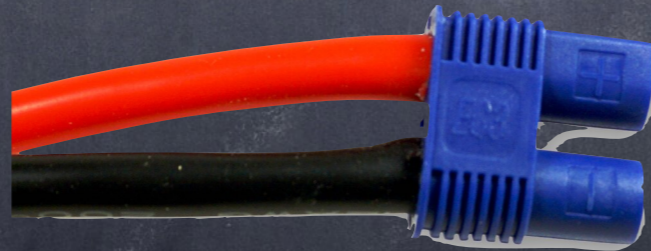
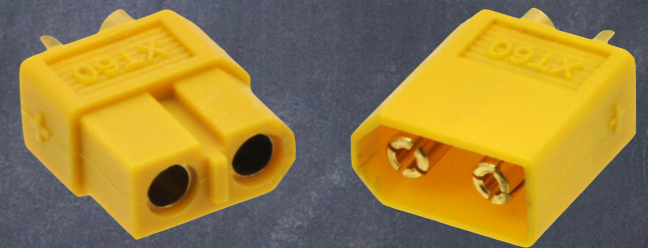
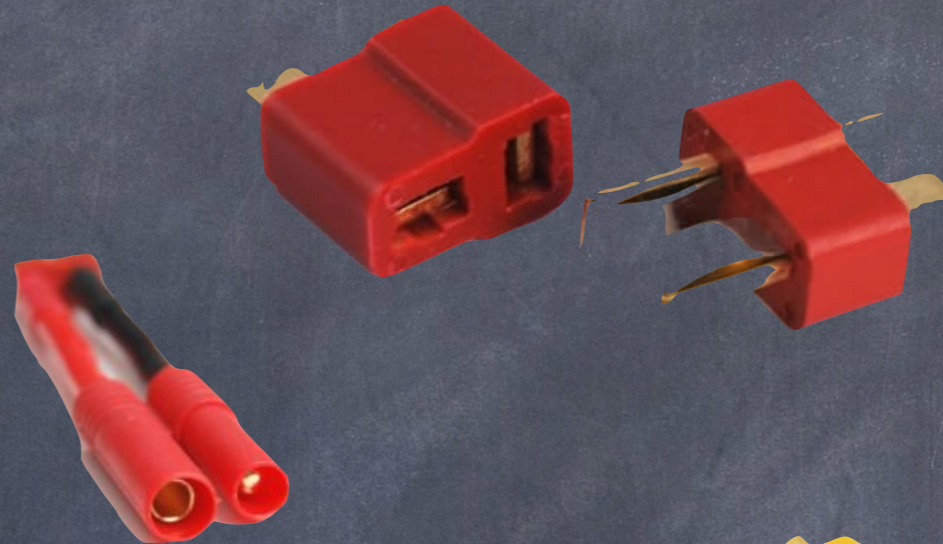
• Deans

• Bullet

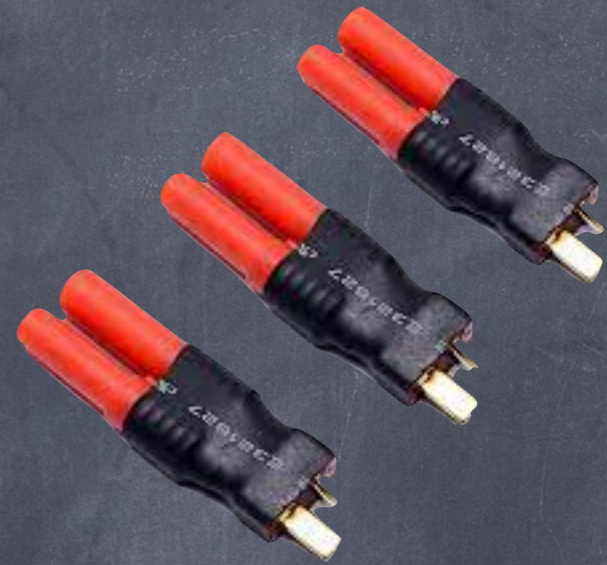
• XT-Type

• EC

• JST



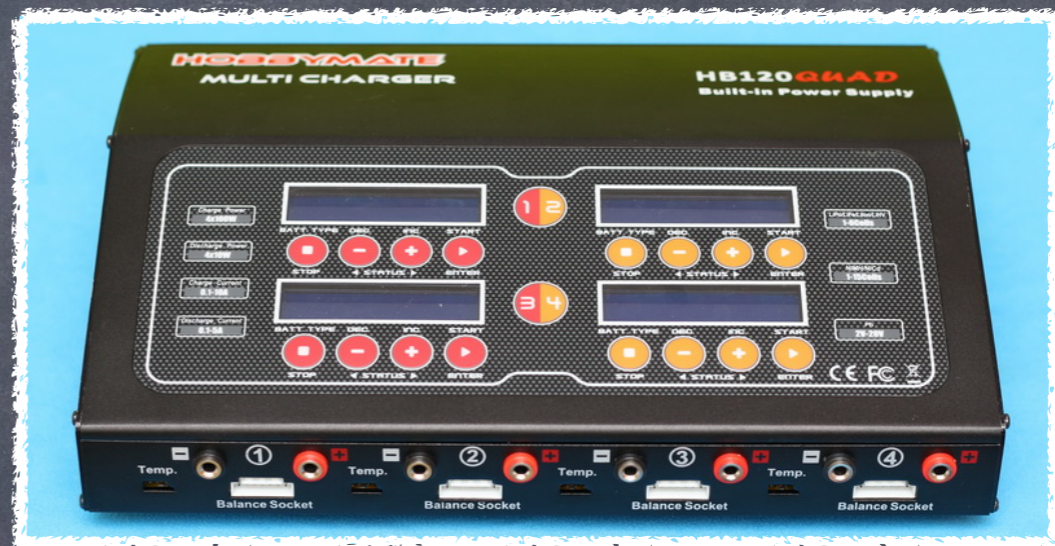
Adapters



Battery Chargers

- ◉ Will handle different types of batteries and different capacities
- ◉ One at a time or multi-charging
- ◉ Balance Charging/Storage/IR
- ◉ Capable of charging:
 - ◉ LiPo
 - ◉ LiFe
 - ◉ LiIon
 - ◉ Lead Acid
- ◉ 12v or 110 or both



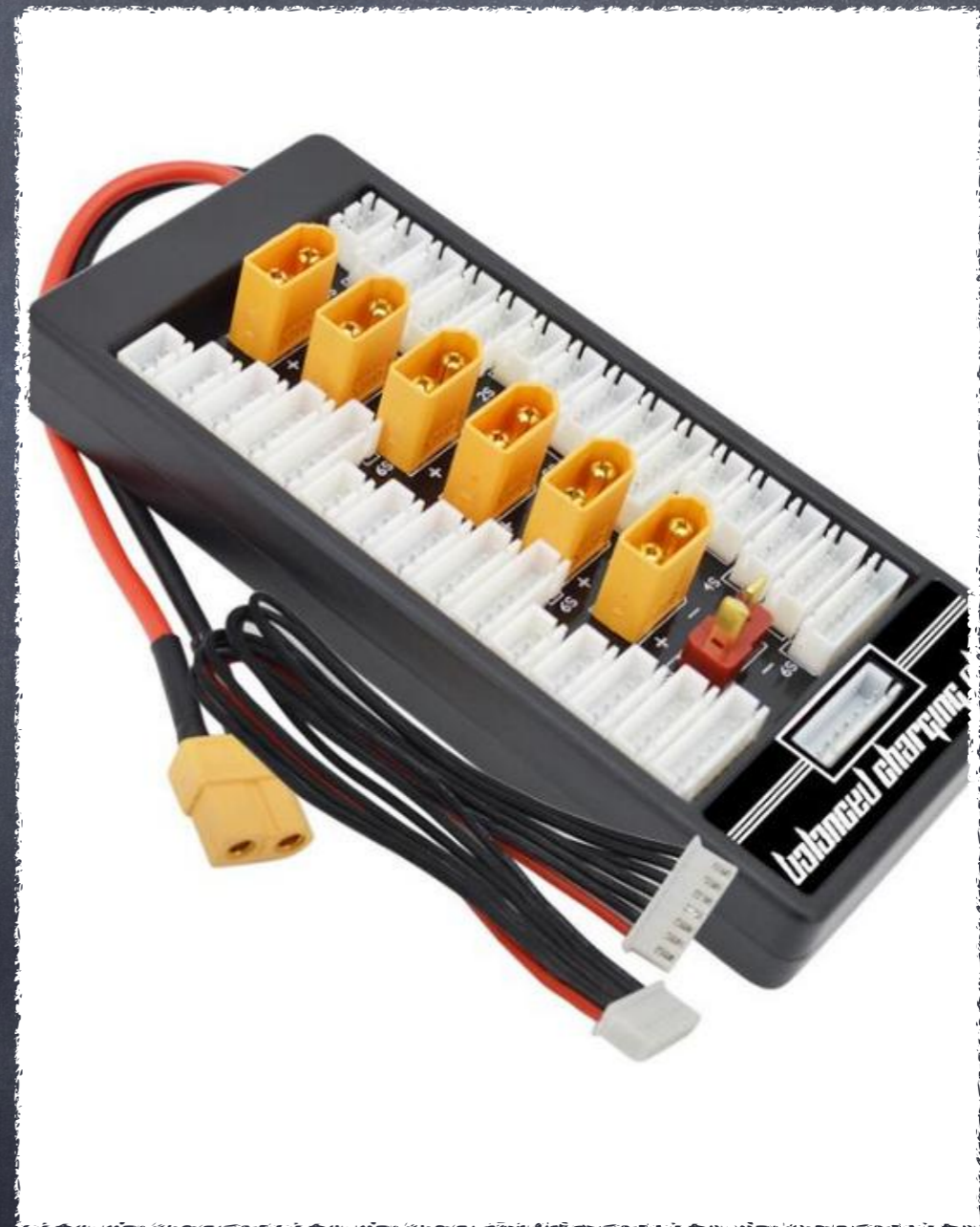


How Many Watts Do You Need?

- Generally, the higher wattage capacity the more adaptable to a wide range of battery sizes
- Watts = Volts X Amps
- Example:
 - 2200 mAh 3S battery = 12.6v
1C charging = 28 watts (12.6v x 2.2 amps)
 - 5000 mAh 6S battery = 25.2v
1C charging = 151 watts (25.2 x 6)
 - Charging multiple batteries at the same time would require much higher wattage requirements
 - My personal charger has 4 channels with 100 watts/channel

Balance Board Use

- Only charge like batteries that are the same age and manufacturer
- Increase the amperage times the number of batteries
 - For example, if you charge 3 2200mAh batteries at the same time, you should charge at 6600mAh



How fast should I charge?

- Battery manufacturers recommend that you charge the battery at the mAh rating of the battery
- Some batteries can be charged at a higher rate, but it reduces their life over time
- Using the 1C charge and keeping your batteries stored at 3.85V should allow for hundreds of charge cycles
- Always use balance charging. Fast charging wears out batteries faster

Safe Charging

- Never leave your batteries unattended
- Charge on a fireproof surface
- Put a smoke detector near your charge station
- Consider using a charging safe (Batsafe)

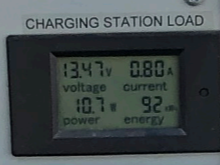
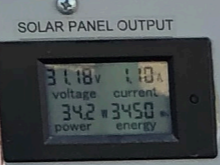




Transporting Your Batteries

Keep it safe!

If you connect your charger and there is no CURRENT displayed on this meter, DO NOT CHARGE. Notify a club officer immediately!



If the VOLTAGE on this meter is less than 12 volts, DO NOT CHARGE. Notify a club officer immediately!



Terminal block with four pairs of terminals (black/red and black/red) and a central black terminal. Wires are connected to the terminals.

Four red rocker switches in a row, used for manual control of the charging station.

TURNIGY 4-port battery charger with ports labeled PORT 1, PORT 2, PORT 3, and PORT 4. It has a digital display and several indicator lights.

Two yellow ZIPPY COMPACT ES500 LiPo batteries. One is labeled '6-2018' and the other '8107-9'. They are connected to a terminal block.

IMAX B6AC Dual Power Professional Balance Charger/Discharger. A blue device with a digital display and various control buttons.

Terminal block with multiple pins and wires connected, likely for connecting the charger to the battery.

Another yellow ZIPPY COMPACT ES500 LiPo battery lying on the blue surface.

PLEASE OBSERVE THE RATES UNTIL WE...
PACK 25 35

Charging at the Field

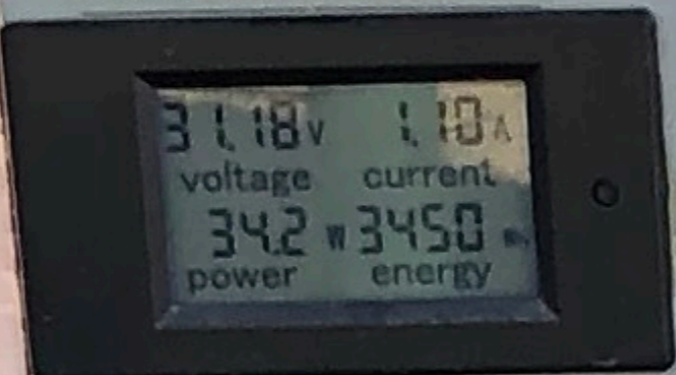
- Be certain to only charge your batteries at the ratings shown on the card attached to the charging station
- Batteries with more than 3 cells charge very slowly
- For 4S or larger batteries, consider charging off of your car battery or bring a generator and your own battery charger
- If you have a multi-port charger, you need to watch the cumulative charge rate.
 - i.e., if you are charging 2 2200 mAh batteries, the total charge is 4400 mAh and the batteries must be charged at a maximum of 4000 mAh

2S	4.0 Amps Charge Rate
3S	4.0 Amps Charge Rate
4S	3.0 Amps Charge Rate
5S	2.5 Amps Charge Rate
6S	2.0 Amps Charge Rate

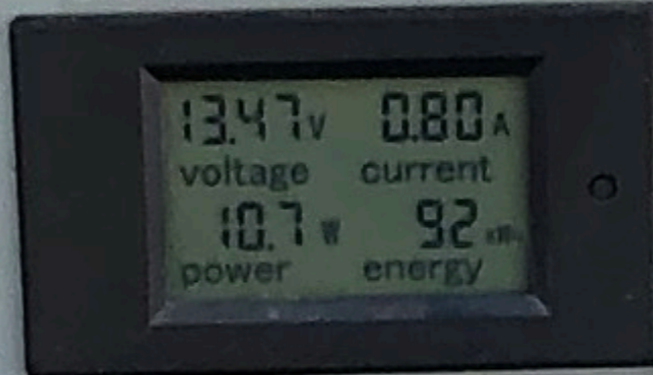
- Do not install higher current rated fuses.
- Watch the battery voltage on the right meter. Terminate all charging if it falls to 11.5 volts.
- Observe polarity: Red is positive (+) Black is negative (-).
- Be mindful of your charger especially if others are waiting to charge.
- In case of problems, notify a PRCF Board Member. Do not open the charge panel.

If you connect your charger and there is no CURRENT displayed on this meter, DO NOT CHARGE. Notify a club officer immediately!

SOLAR PANEL OUTPUT



CHARGING STATION LOAD

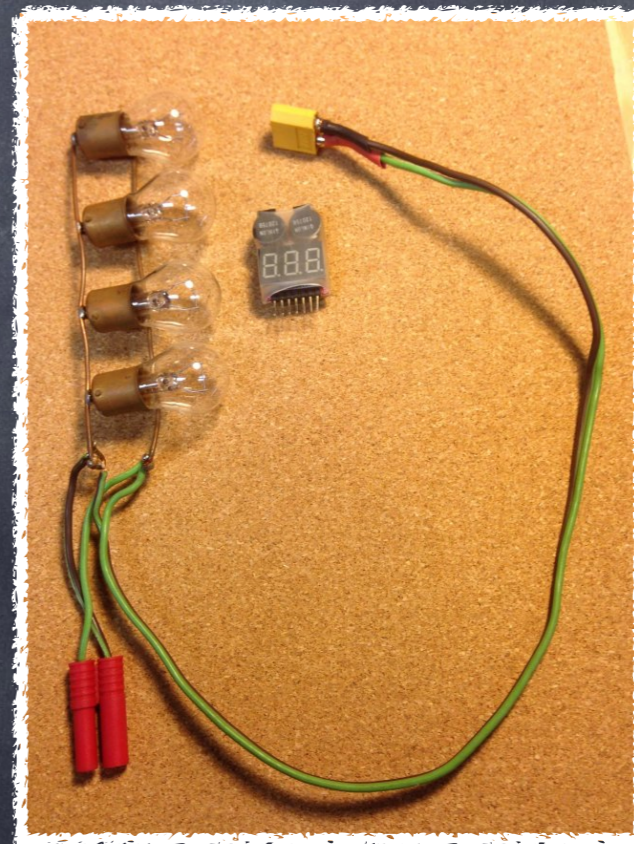


If the VOLTAGE on this meter is less than 12 volts, DO NOT CHARGE. Notify a club officer immediately!



Discharging and Storing

- A variety of discharge possibilities
 - Simply fly your plane to its storage limits
 - Use a discharger
 - Battery charger may also discharge
 - Light bulb discharger
 - Commercial independent discharger



Time to go!

- Puffy batteries
- Hot batteries
- Damaged cells or covering
- Damaged connectors
- High IR



Old or Damaged Battery Disposal

- Salt Water Bath for several days
- Then, safe to throw away in normal trash as lithium does not damage the environment



Where to buy

- Local Hobby Shop – Expensive
- Hobby King, Glacier, Gens Ace
- Smart Batteries – Spektrum and others
- eBay
- Amazon
- Tons of choices – go with a reputable brand.
Ask you buddies what they use.

Recap

- Don't charge batteries unattended
- Buy the highest wattage charger that you can afford
- Balance Charge Your Batteries at 1C
- Discharge your batteries to 3.85v to store
- Periodically check Internal Resistance
- Don't exceed field charger ratings
- Dispose of your batteries properly



THUNDER POWER
LITHIUM POLYMER
5000mAh
66 Pro Lite
5000mAh 4-Cell 14.8V (74 Wh)
25C Continuous Discharge, Burst (11.5A/250mA)
Charge at 0.5A Max

Elite High-Power Series
Lithium Polymer Battery
3S 11.1V 3000mAh 30C LiPo (33.3Wh)
30C (30A) Max. Maximum Continuous Discharge
Charge at 0.5A Max

ElectriFly
LITHIUM-POLYMER BATTERY
3S 11.1V 2500mAh
25C Max. Charge at 0.2A Max

THUNDER POWER
LITHIUM POLYMER
850mAh
45
850mAh 3-Cell 11.1V (9.4 Wh)
10C Continuous Discharge, Burst (1.5A/150mA)
Charge at 0.2A Max

ElectriFly
LITHIUM-POLYMER BATTERY
3S 11.1V 1000mAh
10C Max. Charge at 0.5A Max

THUNDER POWER
LITHIUM POLYMER
1000mAh
10C
1000mAh 3-Cell 11.1V (11.1 Wh)
10C Continuous Discharge, Burst (1.5A/150mA)
Charge at 0.2A Max

Elite High-Power Series
Lithium Polymer Battery
3S 11.1V 400mAh (4.4 Wh)
25C Max. Charge at 0.2A Max
30C (30A) Max. Maximum Continuous Discharge
Please read all safety precautions before use.

XENO
5000
7.4V 5000mAh 35C 37Wh LiPo BATTERY
Duratrax

THUNDER POWER
LITHIUM POLYMER
210mAh
66 Pro Lite
210mAh 3-Cell 11.1V (2.3 Wh)
25C Continuous Discharge, Burst (1.5A/150mA)
Charge at 0.2A Max

FlightPower EON
Lithium Polymer Battery
3S 11.1V 2800mAh (30.8 Wh)
25C Max. Charge at 0.5A Max

BROMIDA
7.4V 1600mAh 20C 12Wh
LiPo Battery

4S-3200
5

ElectriFly
LITHIUM-POLYMER BATTERY
3S 11.1V 1500mAh
15C Max. Charge at 0.5A Max

Next Class

- ◉ Radios and Receivers
 - ◉ Binding
 - ◉ Dual Rates and Expo
 - ◉ Switches
 - ◉ Mixes
 - ◉ Fail Safe